Observations on the Arboreal Snail *Orthalicus floridensis*

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Interest in the famous tree snails of southern Florida can be traced back at least as far as the relatively early scientific account of De Pourtales (1877). Investigators of the last century were primarily concerned with the zoogeography of *Liguus* and the closely related *Orthalicus* because they believed them to be unusually useful in demonstrating certain aspects of Darwinian evolutionary theory and the processes involved in speciation. These colorful snails were also recruited as evidence to support geological theories regarding genesis of the Florida Keys. Pilsbry (1905, p. 38) suggested that the occurrence of a single species of *Liguus* across a wide range of south Florida islands supported Agassiz's theory that the Florida Keys were merely erosional remnants broken up from what had once been a continuous landmass. This pioneer explanation remained popular until the concept of eustacy became well established.

Simpson seems to be the first to have suggested an alternative explanation for the discontinuity of distribution: namely, that these snails are randomly dispersed throughout southernmost Florida by the action of hurricanes. This scattering of colonies is evident in the comprehensive map prepared by Pilsbry (1912) who showed all known populations of *Liguus* and *Orthalicus* that had been discovered by field workers prior to that date. In this monograph Pilsbry discussed both genera and concluded that *Orthalicus* was less extensive (but perhaps more abundant), being found from Cape Sable to Pavilion Key and in the "southern keys." Today the situation is completely reversed: colonies of *Liguus* have become virtually extinct while *Orthalicus* continues to flourish.

Since both snails belong to the South American family *Bulimulidae* it is apparent they represent faunal elements that have been introduced into Florida from the south. In the case of *Orthalicus* there are species ranging from southern Brazil to northern Mexico. Consequently, we have three possible dispersal routes by means of which this snail or its evolutionary progenitors arrived in Florida.

The least likely explanation involves a spread either naturally or with human assistance from northern Central America across the

southern Gulf Coast region and ultimately into the Florida peninsula. This movement could only have occurred during some interglacial interval of the Pleistocene when the climate was much warmer in winter than at present. It is not at all certain that such conditions actually existed; if they did then we must eliminate the intervening Gulf Coast range and treat the Florida colonies as a relict population. However, no fossil specimens of this genus have been reported from Florida, thus invalidating this dispersal route and the possibility that it evolved locally. *Liguus* is believed to be a very recent (Holocene), recurrent introduction from either Cuba or Hispaniola where related species are widespread. But, lack of an indigenous *Orthalicus* in those localities means that it is very unlikely to have had the same dispersal history. Species from Central America are taxonomically similar to *O. floridensis* and we must conclude that it was transported directly across the Gulf of Mexico to the Florida Keys. The question as to whether this occurred on a single or on multiple occasions (by means of hurricanes) has not been resolved.

The present observations were made in connection with a detailed phytogeographic study of Pavilion Key, southernmost of the Ten Thousand Island group and part of the Everglades National Park. The preliminary comments in this paper relate only to the Pavilion Key population where a comprehensive study by specialists is much needed.

As Pilsbry (1912) shrewdly observed, these snails are basically nocturnal and most active during wet intervals. Prolonged dry weather will induce temporary estivation in *Orthalicus* without formation of the strong mucus seal that is produced in the fall with the onset of cold weather. Their internal distribution on the beach strand vegetation of Pavilion Key suggests these snails are also relatively halophobic. While the island maintains a vigorous population, few specimens can be found on vegetation located along the exposed foreslope of the beach strand where it is subjected to salt spray. No specimens were observed feeding on the leeward mangrove community. The greatest concentration of snails seems to occur on certain preferred food trees at or near the inland boundary of beach strand vegetation where plant density and microclimatic conditions approach the characteristics of a true tropical hammock.

This avoidance of the extreme peri-littoral habitat does not nec-

essarily apply to choice of estivation sites, specimens occasionally having been noted in cavities of storm-killed black mangrove [*Avicennia germinans* (L.) Sterns] that line the western winter beach berm of Pavilion Key. A few snails were noted estivating in exposed positions high above ground in the branches of red mangroves (*Rhizophora mangle* L.) immediately adjacent to the easternmost boundary of beach strand vegetation. It seems likely that these specimens represent snails that were either wind-blown into this habitat or wandered across interlocking upper branches. The diurnal incursion of salty water at high tide makes deliberate migration overland unlikely.

Since the existing literature contains few explicit references to feeding habits of arboreal snails in Florida it may be of interest to note that *Orthalicus* have been observed actively feeding on Florida privet [*Forestiera segregata* (Jacq.) Krug & Urban], Jamaica dogwood [*Piscidia piscipula* (L.) Sarg.], wild papaya (*Carica papaya* L.) [see Fig. 1] white stopper [*Eugenia axillaris* (Sw.) Willd.], and strangler fig (*Ficus aurea* Nutt.) in order of preference. These snails were also observed on African bowstring hemp (*Sansieveria thyrsiflora* Thumb.) key lily (*Hymenocallis keyensis* Small), red mangrove (*Rhizophora mangle* L.), buttonwood (*Con-*

Fig. 1. *Orthalicus* feeding on wild papaya, Pavilion Key.

ocarpus erectus L.) and agave (*Agave decipiens* Baker), but evidence of feeding was not noted.

Some tentative identifications of fungi and algae present on Jamaica dogwood from Pavilion Key have been made in an effort to determine the probable diet of these snails. Applying standard incubation techniques, I.M. Master (research asst., Functional Biology Dept., Rosenstiel School of Marine and Atmospheric Sciences) was able to identify *Fusidium, Zygosporium, Gliocladium, Cladosporium, Macrophoma,* and *Rhizopus* colonies growing on the surface of the branches. From separate cultures transferred to agar plates *Syncephalastrum, Penicillium, Cladosporium, Aspergillus, Streptomyces, Verticillium, Cephalosporium, Fusidium,* and *Phoma* were identified. Most of these fungii are common general saprophytes having a widespread distribution; no predominant fungus was noted on the sample tested.

Thirteen adult specimens of *Orthalicus* were transferred in Oc-

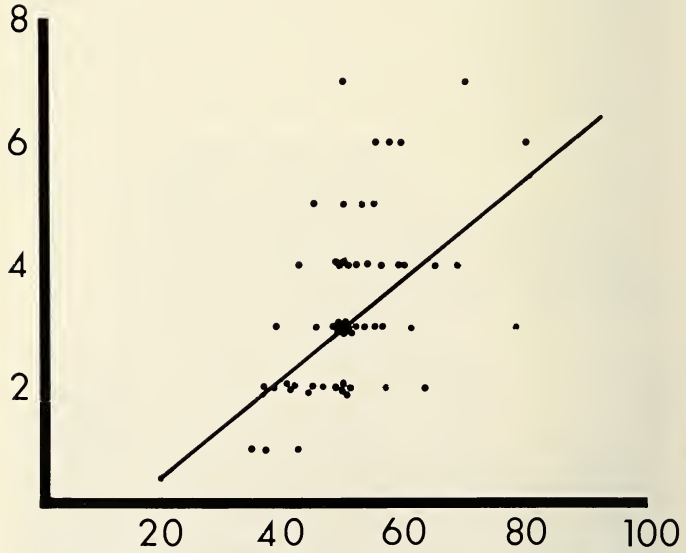

Fig. 2. Scatter diagram; Length (mm)-Age (yrs) for *Orthalicus floridensis.*

tober from Pavilion Key to a latitudinally equivalent location on the east coast of Florida where they were released on a variety of exotic ornamentals. The majority escaped within 48 hours but several that remained on ylang-ylang (*Cananga odorata* Hook. f. & Thoms.) for longer periods were observed to feed sporadically although no macro-epiphytic flora was apparent. Better results were obtained by placing the snails on banana plants (*Musa sapientum*) where they ingested the cutin layer of petioles. This diet was evidently not entirely acceptable as 11 specimens eventually relocated themselves on two mature cultivated papaya trees whose trunk surfaces supported a flourishing algae mat. In slightly less than 14 days the snails completely removed all visible trace of algae from the host trees. They then began to disperse across a residential grass lawn (treated with herbicides and insecticides) and were all found dead within a few meters of the trees.

A statistical age-growth study was made from a representative sample of dead shells collected at various points on Pavilion Key. The results are shown on the scatter diagram (Fig. 2) which indicates a mean age of 3.36 years and a corresponding length of 51.6 mm. The largest specimen collected measured an impressive 92 mm by 48 mm making it perhaps the largest indigenous terrestrial snail ever recorded from the United States and one of the largest arboreal snails found anywhere in the world. This exceptional specimen was so faded that no variceal age estimate could be made. If each major dark brown variceal does in fact correspond to a winter estivation period, then the maximum age noted among the sample specimens was 7. However, any analysis based on these markings may be affected by intermittent markings induced from temporary estivation during dry spells. If the more prominent varices correspond to a winter estivation instead of being continuously deposited and resorbed, then all specimens in the sample died during a winter season. This suggests *Orthalicus* is particularly sensitive to cold. Every empty shell examined was intact without indications of crushing or breaking by crabs or other predators (Rhoads, 1899, p. 45).

The absence of *Orthalicus* colonies in the less accessible areas of the heavily urbanized Florida east coast is probably related to the lack of a suitable forage habitat. Their introduction into the few remaining stands of hammock vegetation is recommended where

specimens of preferred food trees are present. A program of careful redistribution would disperse the population and help insure survival by reducing the possibility of extinction through destruction of the few remaining colonies.

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